

SSPC: The Society for Protective Coatings

Paint Application Guide No. 11

Protecting Corners, Edges, Crevices, and Irregular Steel Geometries by Stripe Coating

1. Scope

1.1 This guide discusses the technique called “stripe coating” or “striping” as a way of providing extra corrosion protection measures on edges, outside corners, crevices, bolt heads, welds, and other irregular steel geometries, including optional techniques that can be used to improve coating performance. It is not intended to provide all-encompassing guidance but rather offer options when preparing a project specification. The engineer should evaluate and address details on a project-specific basis.

1.2 Appendix A contains recommendations and sample language to assist the specification writer in addressing corrosion protection of edges, crevices, and irregular steel geometries, and Appendix B contains representative photographs of configurations or geometries that may benefit from stripe coating.

1.3 Units of Measure: This guide makes use of both the ASTM⁽¹⁾ SI 10, “American National Standard for Metric Practice” International System Units (SI) units and U.S. Customary units. The measurements are not exact equivalents; therefore each system must be used independently of the other, without combining in any way. This guide uses SI units with the U.S. Customary conversions shown in parentheses.

2. Definitions

Bolted Connection: Two or more steel plates connected by a mechanical fastening system consisting of a threaded metal rod or pin (bolt) joined to a metal nut (with or without a washer).

Corner: The intersection of two surfaces.

Crevice: A narrow opening; fissure.

Edge: An exposed, through-thickness surface of a plate or rolled shape created either during the rolling process (for example the as-rolled side face of a beam flange, channel flange or angle leg), or by thermal cutting, sawing, or shearing. Edges may be planar or rounded, and either perpendicular or skewed to adjacent faces.

3. Background

3.1 Sharp edges, outside corners, crevices, and welds are often sites where coating failures and corrosion begin due to reduced coating barrier protection (see Figure 1). Reduced coating thickness on these surfaces can be a result of application of inadequate amounts of coating, but the surface tension of the wet coating or coating shrinkage during the drying/curing process can also pull the film away from edges. Sharp edges resulting from cutting, burning, and shearing are especially difficult to coat adequately. Bolt threads and fastener systems combine the adverse effects of sharp edges and crevices. Crevices, depending on their inherent width, are also difficult to protect using coatings. Wet coating may flow over rather than into tight crevices, creating a temporary bridge over the crevice that opens as the coating cures and shrinks, thus leaving the crevice interior unprotected. In this case caulking is oftentimes a better alternative. All of these irregular geometries are susceptible to premature corrosion.

3.2 A “stripe coat” is a layer of coating applied to specific areas such as edges, welds, outside corners, bolt heads and threads, nuts, and crevices, to provide additional barrier protection. The stripe coat may be applied either before or after a layer of coating (often called a “full coat”) is applied over the entire surface being coated. The practice of applying a stripe coat is frequently referred to as “striping.” The coating manufacturer should be consulted on whether application of a stripe coat is recommended, as well as the thickness of the stripe coat. The project specification should provide detailed instructions on the surfaces to be stripe coated.

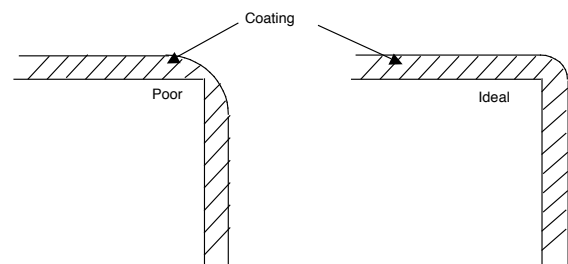


Figure 1. Schematic showing how coating thickness is reduced at a sharp corner.

⁽¹⁾ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Standards available online from <<http://www.astm.org>>

This guide was first issued in 2008 and was revised in 2020 by SSPC C.3.16.

3.3 There are several factors and options to consider when specifying protection of edges, crevices and irregular geometries; the option of choice may be determined by the best cost/benefit ratio. Factors that enter into a cost/benefit analysis include the severity of the service environment (e.g., atmospheric versus immersion or below grade), interference with production during maintenance, difficulty in accessing the structure to perform maintenance painting, width of crevices, and aesthetics (e.g., architectural applications). These factors are often unique to each project. In some cases, both preparation and stripe coating may be specified for a given configuration or environment.

4. Preparing Outside Corners and Sharp Edges

4.1 Sharp corners may be avoided at the fabrication stage. They can also be remedied by grinding after construction, but at a much higher cost. When filing (grinding) corners, care should be taken to assure that additional sharp corners are not created while modifying the original corner. It is generally much less expensive and easier to grind corners in the shop than in the field since the work is more accessible. In addition to corners, rough surfaces such as weld caps should also be ground smooth. NACE Standard SP0178¹ provides guidance on finish requirements for welds for immersion environments.

4.2 Common options for preparation of outside corners, if corner preparation is determined to be necessary, include one grinding pass, three grinding passes (shown in Figure 2), or 2 mm [1/16 in] radius (sometimes known as “2R”). The increased performance resulting from corner or edge grinding depends on the service environment, the generic type of coating or coating system and the degree of grinding specified (see Appendix A1). For example, the International Maritime Organization (IMO) Performance Standard for Protective Coatings (PSPC)² requires either a 3-pass or 2R preparation of all corners inside ballast tanks since seawater is frequently used for ballast. It should be noted however that the cost differential between one pass and three pass (or radiused) corner preparation is substantial and the specification writer should carefully consider the degree of corner grinding required and even conduct a cost-benefit analysis prior to invoking such requirements in a specification.

4.3 The use of coatings with edge-retention properties (see Section 5.1.3) may minimize or eliminate the need for corner grinding. It is important to note that corners in the as-rolled condition are not normally in need of any treatment and that some corner “softening” (flattening) occurs during blast cleaning; however, blast cleaning alone will not sufficiently break a sharp corner.³

4.4 Flame-cut edges can be ground over the entire edge surface to remove the hardened surface layer resulting from flame cutting and permit creation of a profile (see

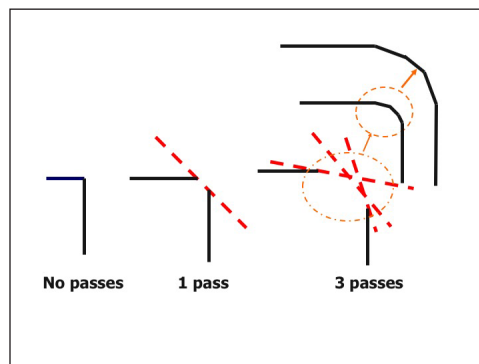


Figure 2. Options for Preparation of Outside Corners.

Appendix A2). Grinding on flame cut edges can be used to remove martensite, a hardened form of steel that may result from rapid re-solidification following flame cutting. This layer is typically very thin, about 0.25 to 0.50 mm (0.01 to 0.02 in) thick and is dependent upon the chemistry and thickness of the steel. Light grinding is generally sufficient to remove this material and is only necessary if the hardness interferes with achieving the desired profile during blast cleaning. The very rapid heating and cooling from plasma or laser cutting are unlikely to cause the formation of martensite.

5. Stripe Coat Application

5.1 The project specification normally specifies the areas to be stripe coated, allowable methods of stripe coat application (brush or spray), whether to apply the stripe coat before or after the full coat, the coats that are to be “stripe” applied, whether tinting of the stripe coat or use of another color of coating is required, and information on the drying/curing requirements between application of the stripe and full coat (may defer to the coating manufacturer). “Wet” striping is typically regarded as the application of a stripe coat that is permitted a short dry time (i.e., <5-10 minutes), before a full-coat application of the same product. “Dry” striping is typically regarded as the application of a stripe coat that is permitted the manufacturer’s minimum recoat time (e.g., 4-8 hours) before the application of a full coat. Dry striping is generally performed after the full coat of primer has been applied to prevent rust-back of prepared steel surfaces.

5.1.1 Welds and crevices are best protected when striped with a coating with good wetting properties such as 100%-solids penetrating sealers, while high-build coatings are best for striping edges. However, it is impractical to specify two different stripe coatings on a structure with edges, crevices, and welds; therefore, the stripe coating selected should be capable of functioning on all areas where striping is required.

5.1.2 The coating manufacturer should be consulted to determine the appropriate coating to use as a stripe coat. If the stripe coat contains a zinc loading and is to be applied over a surface already primed with inorganic zinc, an organic zinc primer should be used for the stripe coat,



Figure 3. Example of Stripe Coat.

as inorganic zinc coatings do not bond well to themselves. High-solids coatings may have relatively short dry times and may not possess good wetting properties, which are important for proper performance of stripe coats. In such cases, a compatible stripe coat with a slower drying time and improved wetting capability should be used with the high-solids coating. The coating selected for stripe application should be appropriate for the service environment.

5.1.3 Coatings with Edge-Retention Properties:

Coatings with edge-retention properties can provide improved film build (retention) at corners and improve protection in these critical areas. The edge-retention properties of a coating should be established prior to its use. A method for measuring the edge-retention properties of a coating is published in MIL-PRF-23236.⁴ This test method compares the film thickness of three specimens cut from a sample of coating applied to a non-chamfered 90-degree angle. The ratio of the film thickness at the apex vs. the film thickness on the flat area is calculated and expressed as the percentage of edge retention of the coating, as shown in Figure 4. According to MIL-PRF-23236, any specimen having less than 50 percent edge retention fails the test. An average value of 70 percent edge retention for three test specimens measured using an optical microscope is required to qualify a coating as having edge-retention properties.

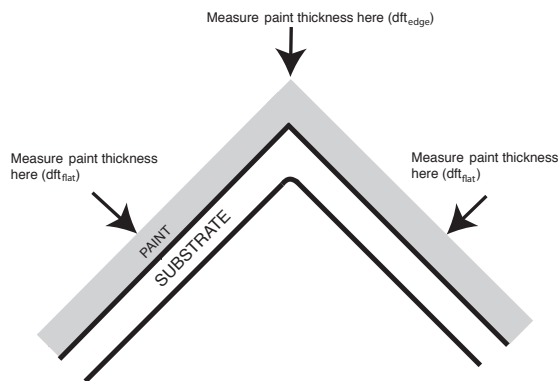


Figure 4. Diagram of edge retention test (courtesy of MIL-PRF-23236C)

The edge retention percentage is calculated as:

$$\% \text{ Retention} = \text{dft (edge)} / \text{dft (flat)} \times 100$$

Note that very sharp corners, or “knife edges,” are very difficult to protect, even with coatings having edge-retention properties. In order to improve corrosion protection, “knife edges” should be modified as described in Section 4 before the coating is applied.

5.2 WHAT COATS TO STRIPE: Usually, a stripe application of the primer coating is specified to increase primer thickness. Occasionally, multiple stripe coats may be required over rough hand welds. In critical areas, the specifier may require that striping be done for two or more coats in a multi-coat system.

5.3 AREAS TO STRIPE

5.3.1 The facility owner/specification writer normally determines whether stripe coating is warranted for some or all areas of the particular project. Sometimes only specified areas of outside corners, edges, welds, and crevices are required to be stripe coated. Stripe coating is most effective on corners that are either rounded or chamfered by grinding (see Section 4) but may not be required if edge-retentive coatings are used.

5.3.1.1 Situations where stripe coating is usually warranted include:

- Immersion service (e.g., interiors of fuel or water storage tanks; ship hulls)
- Areas with high corrosion rates (e.g. cooling towers and splash zones)
- Areas where access is difficult (e.g., towers, some bridges).
- Built up members (e.g., lattice bars and boxes)

5.3.1.2 Situations where stripe coating may not be cost-effective include:

- Non-critical components (e.g., interior wall in living space on a ship)
- Mild exposure (e.g., SSPC environmental exposure zones 1A and 1B)⁵
- Inside corners (can be adequately covered using proper spray technique)

5.3.1.3 Areas that are usually stripe coated include:

- Crevices
- Plate and sharp edges
- Plate seams
- Back-to-back angle seams (built up members)
- Pitted steel
- Bolt heads and nuts
- Rivet heads
- Welds
- Other sharp discontinuities
- Outside corners